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HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

INFORMATION CIRCULAR

USE OF WETTING AGENTS FOR ALLAYING COAL DUST IN MINES

BY

IRVING HARTMANN AND H. P. GREENWALD

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USE OF WETTING AGENTS FOR ALLAYING COAL DUST IN MINES[1]

By Irving Hartmann[2] and H. P. Greenwald[3]

CONTENTS

	Page
Introduction	1
Character of wetting agents	4
Application of wetting agents in coal mines	5
Bureau of Mines tests of wetting agents	6
Tests of wetting power	6
Explosibility tests	7
Investigation of wetting agents in Great Britain	7
Use of wetting agents along roadways	8
Suppression of coal-dust clouds	11
Summary	12

INTRODUCTION

The object of this paper is to summarize briefly some experiments with wetting agents conducted by the Bureau of Mines in the United States and by others in British coal mines and to call attention to their possible application in American coal mines as an aid in suppressing coal dust. Considerable quantities of coal dust are made in mines in the course of such mining operations as drilling, undercutting, blasting, loading and hauling. When in suspension in mine air, coal dust is considered by some to be injurious to the health of the miners; undeniably it reduces visibility and comfort at working places. Deposited on surfaces from which it can be swept readily into the air in a dense cloud, it is a grave potential explosion hazard.

To combat the danger of mine explosions, the Bureau of Mines advocates the use of rock dusting, as expressed in its Mine Safety Board Decision 32:[4]

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7131."

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[4] Mine Safety Board, Prevention of Coal-Dust Explosions by Rock Dusting. Decision 32 (superseding Decision 5): Bureau of Mines Inf. Circ. 7109, March 1940, 3 pp.

To prevent the propagation of mine explosions, the Bureau of Mines recommends:

1. That all coal and lignite mines, except anthracite mines, shall be rock dusted.

2. That rock dust shall be distributed upon top, bottom, and sides of all underground openings of every description, to within at least 40 feet of all working faces, and the areas not rock dusted shall be kept wet.

3. That rock dust shall be maintained in such quantity that the incombustible material in representative samples of dust collected shall not be less than 65 percent. Where methane gas is present in the ventilating current, the minimum percentage of incombustible matter in the mine dust shall be increased 1 percent for each 0.1 percent of methane.

It is obvious that rock dusting of this degree cannot be maintained economically if coal dust is produced in large quantities and scattered widely by air currents or the regular operations of mining. This is particularly true at and near working faces and at certain other places, such as conveyor ends, where coal dust, if dry, is thrown into the air more or less continuously and where it is carried along the mine roadways by the ventilating current. Various methods have been advocated for reducing the dust concentration at these places, namely, the use of exhaust and other types of dust collectors, the practice of wetting with water to cause settling of the dust, and the removal of settled dust and cuttings from the mine.

Mine Safety Board Decision 26[5] of the Bureau states that:

> In the interest of health in mining and tunneling wherever dust is produced which is of such character[a] and in such concentration[b] in the air of the working places as may be harmful to breathe, the United States Bureau of Mines recommends:

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a/ Character of dust refers to size and composition, such as siliceous dusts and other dusts poisonous in effect.

b/ Concentration of dust in air refers to amounts, varying with the character, that will be harmful to breathe. The determination of the amount of each specific dust and the method of sampling are subjects of research by the United States Bureau of Mines in cooperation with the United States Public Health Service. Reports and tentative recommendations on these subjects are issued from time to time by these organizations.

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[5] Mine Safety Board, Recommendations of the United States Bureau of Mines on Certain Questions of Safety as of October 1, 1936: Bureau of Mines Inf. Circ. 6946, 1937, p. 35.

> That the dust produced be so wetted,[c] trapped,[d] or otherwise treated,[e] and the place where men are working be so ventilated,[f] that there shall not be a harmful concentration in the air of the place.
>
> ---
>
> c/ "Wetted" means as may be done by sprays or jets of water or chemical solutions; in drilling, the wetting in the drill hole may be done by water-injection drill or solution-injection drill.
>
> d/ "Trapped," as may be accomplished by suction of the dust-laden air and collecting the dust in an apparatus of one kind or another.
>
> e/ "Treated," as may be done by chemical solutions applied, as stated above, by sprays, jets, or injection drills.
>
> f/ "So ventilated" means by air currents of sufficient velocity and volume to carry away from any working place harmful dust not caught by wetting or by trapping devices and, wherever possible, discharged into the return airways.

In Mine Safety Board Decision 15[6] the following recommendations are made:

> In the interest of safety in coal mining, the United States Bureau of Mines, to lessen the coal-dust explosion hazard, recommends that:
>
> 1. Machine cuttings be wetted as the cutting is being done.
>
> 2. The coal face and the working place 40 feet therefrom shall be kept free of coal dust by the use of water.
>
> 3. The tops of loaded cars in the working place shall be wetted.

Mine Safety Board Decision 17[7] recommends the following:

> To lessen the formation and distribution of coal dust in haulageways, the United States Bureau of Mines recommends that in bituminous and subbituminous coal mines:
>
> 1. The mine cars should be constructed and maintained dust-tight.
>
> 2. The coal should be so loaded that it will not shake off in haulage.
>
> 3. The cars and loads should be so sprayed as to prevent dust being distributed along the haulageways.

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[6] See reference of footnote 5, p. 25.
[7] See reference of footnote 5, p. 26.

The use of water by sprays and other means of allaying coal-dust clouds and for keeping settled coal dust moist so that it will not disperse is practiced only to a very limited extent in coal mines of the United States. Various reasons for this have been advanced by men connected with the industry. Undoubtedly the fact that fine coal dust is hard to wet has been a factor in some instances; violent agitation of the dust and water is necessary to accomplish this. The surfaces of coal particles are water-repellent, and there is only slight tendency for them to absorb water from atmospheres of high humidity. In recent tests by the Bureau of Mines it was determined that a half-inch-thick layer of mine-size Pittsburgh-bed coal dust kept in a cabinet for 13 days at 90 to 95 percent relative humidity and at a temperature of approximately 60° F. absorbed less than 1 percent of its own weight of moisture.

Several years ago a number of coal mines applied solutions of calcium chloride and in some instances sodium chloride in dusty locations to induce absorption of moisture from the mine air and help to retain the moisture in the dust. These trials were only slightly successful; frequently the salt solutions caused water to collect in pools on top of the dust without effectively wetting it. Recently, however, various chemical compounds known as wetting agents have become available commercially, which when mixed with water markedly increase its wetting ability. These can be of real aid in wetting coal dust in mines, as they cause water to penetrate through dust masses and wet all particles touched. They do not, however, cause retention of water against the drying effect of air currents.

CHARACTER OF WETTING AGENTS

The term "wetting agents" is applied to substances (generally organic compounds of somewhat complex structure) that, when added to water, enable the latter to wet materials that otherwise could be wetted only slowly or not at all. These compounds are applied in various industries. They are employed in the textile industry to aid in the wetting of cotton and other fibers. They are added to horticultural sprays and washes for wetting the surfaces of leaves, which are strongly repellent to water. In metallurgical flotation processes wetting agents are used as frothers, as emulsifiers, as selective collectors, and as a source of large ions that are either positively or negatively charged and that have specific collecting properties.[8] In the du Pont sink-and-float process of coal washing,[9] very dilute solutions (0.01 percent) of certain "active agents" (wetting agents) are sprayed onto the coal before it enters the separating liquid. A film of this agent is formed around the coal particles and adheres so strongly thereto that it is not displaced by the separating liquid during the process; in this way loss of considerable amounts of separating liquid, which would be carried away with the coal, is prevented. Wetting agents used in this work include starch acetate and tannic acid.

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[8] Dean, R. S., Clemmer, J. Bruce, and Cooke, S.R.B., Use of Wetting Agents in Flotation. In Progress Report 15, Metallurgical Division: Bureau of Mines Rep. of Investigations 3333, 1937, 50 pp.

[9] Foulke, W. B., Sink-and-Float Processes for the Beneficiation of Anthracite: Trans. 2nd Ann. Anthracite Conference, Lehigh University, April 1939, pp. 229-238.

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The physical processes involved in wetting actions are complicated and are not completely known for many cases. The relative importance of different phases of the process varies according to the nature of both the wetting solution and the material being wetted and even according to the manner in which they are brought together. In the wetting of coal dust, the great reduction of the surface tension of water by the wetting agent dissolved therein is an important factor. Wetting of the dust has been shown to take place in two stages: First, there is movement of a liquid film along the solid surface and, second, air from the remaining capillary spaces is displaced by the liquid.

APPLICATION OF WETTING AGENTS IN COAL MINES

Several possible applications for wetting solutions have been suggested with a view to abating the dust nuisance in coal mining. They may be employed, for example,

1. To prevent rising of coal dust on high-speed haulageways and other mine roads.

2. To assist settling of coal dust at the face of mine workings and at conveyor loading points.

3. For spraying during cutting of coal, provided the solution has no corrosive effect on steel.

4. In connection with drilling in coal mines as well as metal mines, in place of ordinary water injection and in place of dry drilling.

5. For spraying the tops of loaded coal cars.

6. For spraying the surface of stock piles of coal to prevent dust nuisance.

In addition, the suggestion has been made that wetting solutions might be sprayed on the floor of mine roadways to prevent dust on such floors from propagating an explosion. It was thought that application of the wetting agent might cause a strong consolidated crust to form at the surface of the dust and in addition promote the retention of enough moisture in the underlying layers to render the coal dust nonexplosive. This idea has absolutely no chance of successful application. Tests in the Bureau's Experimental coal mine have indicated unmistakably that it is impossible to wet coal dust enough or to bind it otherwise so that it cannot be raised as a cloud in air by the forces present in a mine explosion. The fallacy of the method has been shown also by numerous explosion disasters in mines in this country as well as abroad in which wetting methods were practiced to the exclusion of rock dusting.

At the request of several persons, the Bureau of Mines made some tests a few years ago to determine whether wetting agents would be of some help in preventing the propagation of coal-dust explosions; this work is outlined briefly below.

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BUREAU OF MINES TESTS ON WETTING AGENTS

The Bureau's work on wetting agents for the treatment of coal dust was limited in scope. The work fell into two categories: (1) Tests of the wetting power of the agent and (2) tests of the explosibility of coal dust treated with an emulsion of the wetting agent and then dried.

The wetting agent used in all tests was Ninol W-433 manufactured by Ninol, Inc., 510 North Dearborn Street, Chicago, Ill. It is a brownish, somewhat sirupy liquid, which forms an emulsion with water; tests indicate that there is a limit to the amount that can be kept in emulsion permanently. Beyond the fact that it is an organic compound, its chemical composition was not revealed. Alone, it has little or no tendency to evaporate when exposed to air at room temperature.

Tests of Wetting Power

The coal dust used in these tests was prepared by crushing lump coal taken from the Pittsburgh coal bed in the Experimental mine. On an average, this coal contains 40 percent volatile matter on a moisture-and-ash-free basis. The dust used was 89.3 percent minus 20 mesh and 18.6 percent minus 200 mesh; this size is comparable with that of dust found along the roadways in a majority of coal mines.

The wetting agent was used as a 1-percent (by weight) emulsion in water. There was no tendency toward separation of the wetting agent and water in an emulsion of this concentration. The dust was placed in enameled steel trays to a depth of approximately 1-1/4 inches, then the wetting solution was sprinkled over the dust in amounts ranging from 5 to 15 percent of the weight of the dust and allowed to penetrate by its own action. Evaporation of the water was observed under different conditions of temperature and humidity.

The tests indicated that the emulsion has considerable ability to penetrate a deposit of bituminous-coal dust. The depth of penetration depended on the quantity of emulsion used and the rate at which water evaporated. Under the most favorable conditions tried, this depth did not exceed one-half inch. During rapid evaporation, at an average relative humidity of 25 percent and at 70°F., nearly all the added water evaporated in 2 to 3 days. At a humidity of 60 to 70 percent, temperature of 70°F., all the water evaporated in 20 to 35 days. After all the water had evaporated, the top layer of dust was bound together in a fairly strong crust by the wetting agent, the strength of the crust depending on the quantity of wetting agent used and on the time required for drying.

In several tests plain water was sprinkled on the dust after it had dried following application of the emulsion. Sprinkling was carried on until the dust could absorb no more water. These tests showed that the dust originally treated with the wetting solution could be rewetted readily with water alone. However, as the wetting agent was not hygroscopic, it could not hold the moisture against evaporation, and the water again escaped into the atmosphere.

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In a few tests calcium chloride was dissolved in various proportions in the wetting emulsion, and the resulting solutions were sprayed on coal dust. As far as could be observed, the calcium chloride did not affect the penetrating power of the wetting agent. It did cause retention of moisture to the same extent as it would alone, and the amount of moisture retained depended on the proportion of calcium chloride present and on the humidity of the air over the dust.

Explosibility Tests

These tests were made in the Experimental coal mine of the Bureau. The general test procedure was somewhat similar to that used in the usual explosion test work with coal dust and with mixtures of rock dust and coal dust; the method is described briefly in Bureau of Mines Bulletin 268.[10] Two series of tests were made; in the first the dust was premixed with the wetting solution before being placed in the test zone in the mine; in the second the dust was placed first along the floor of the test zone and then sprayed with the wetting solution. In both instances, after the dust was placed in the mine it was dried by an air current induced by the ventilating fan, and the explosion was initiated under standard test conditions after most of the added moisture had evaporated from the dust. This left in the coal dust only the wetting agent, which ranged in amounts from 0.0 to 1.6 percent by weight of dust.

These tests showed, among other things, to what extent a crust was formed on the dust by the wetting solution. With the premixed dust, virtually no crust was formed, while with the dust wetted in place a crust approximately 1/8-inch thick was formed. This crust was entirely unable to hold the dust in place against the forces acting in the test explosion, and flame propagated through the dust with the same violence as in testing untreated coal dust. It was concluded from the above work that while use of the wetting emulsion may abate a dust nuisance, it is absolutely no protection against dust explosions.

INVESTIGATION OF WETTING AGENTS IN GREAT BRITAIN

In Great Britain considerable research and test work has been carried on with wetting agents, both in the laboratory and underground, largely under the guidance of the Safety in Mines Research Board. The studies were begun as early as 1924; numerous wetting agents were tried, many of which find application in other industries. One compound, known as Perminal W, a sulfonated hydrocarbon derivative manufactured by Imperial Chemical Industries, Ltd., has been found superior to all others tested in its general utility, as shown by laboratory tests and trials underground.

For purposes of this discussion the British tests may be divided into two classes, namely, application of wetting agents for consolidating coal dust settled on traveling and haulage ways and use of wetting agents for suppression of coal-dust clouds during drilling, blasting, loading, and other operations.

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[10] Rice, G. S., Paul, J. W., and Greenwald, H. P., Coal-Dust Explosion Tests in the Experimental Mine, 1919 to 1924, Inclusive: Bureau of Mines Bull. 268, 1927, 176 pp.; see pp. 35-36.

Use of Wetting Agents Along Roadways

Most of the British research work on wetting agents was concerned with the development of a satisfactory means for wetting dust lying on mine roadways and thereby preventing it from rising into the air during the travel of men and animals. This particular problem is of greater importance in British than in American coal mines, as the British mines are much deeper and consequently hotter and drier, and dust can be raised from the floor more readily. The haulage systems in use are such that the men must walk longer distances to reach their working places than in our mines, and this necessitates regular maintenance of traveling ways in such condition that walking is not made too difficult by the dust on the floor.

Tests and observations have shown that the following are some of the properties that a satisfactory wetting agent for coal dust should have: (1) The wetting solution should wet the surface of the dust rapidly and thus avoid running into pools; (2) the wetted layer first formed should be permeable to the solution; and (3) the solution should percolate readily through the deposit and should not lose its activity by too powerful adsorption of its active agent by the surfaces of the dust particles. The selection of the wetting solution for the laying of floor dust on mine roadways is determined by a compromise between the above properties. As mentioned previously, of the wetting solutions tried by the British the compound Perminal W was found most generally useful, although several compounds of higher initial activity also were tried; it was found, however, that the latter are adsorbed too rapidly by coal dust and lose their activity quickly, whereas Perminal is not too strongly adsorbed and can penetrate thick dust layers.

A general description of the use of wetting agents on mine roadways is given in a paper by Tideswell and Wheeler,11/ and a detailed description of the application on a traveling road is given by Hay and Tideswell.12/ According to the latter article, the treatment was applied to a 600-yard-long section of a main return airway in the Thorpe colliery near Sheffield. The passageway was approximately 9 feet wide by 7 feet high. The dust deposit had an average thickness of slightly over 1 inch, ranging from 4 inches at the sides and against the rails to 1/2 inch on the walking paths; the dust was about 25 percent coal and 75 percent rock or stone. Three shifts of men and ponies passed to and fro each day and raised considerable dust. The air current was about 600 feet per minute, the temperature 67°F., and the relative humidity 85 percent.

To lay the thick and irregular deposit of dust in this roadway it was necessary to obtain as rapid a surface wetting as possible and to avoid spraying too large a volume of solution in one operation lest some be lost by drainage from the thicker parts of the deposit. After some preliminary trials the following procedure was adopted:

11/ Tideswell, F. V., and Wheeler, R. V., Dust-laying on Mine Roadways: Trans. Inst. Min. Eng., vol. 87, 1933-1934, pp. 1-8.

12/ Hay, J. L., and Tideswell, F. V., The Treatment of Dust on Traveling Roads: Trans. Inst. Min. Eng., vol. 90, 1935-1936, pp. 213-223.

1. Spraying with 3-percent solution of Perminal W at a rate of 2 to 4 gallons per 100 square feet of floor surface, according to the ability of the surface to carry it without loss by drainage.

2. Repetition of this treatment after 1 hour if the average thickness of the dust deposit approached 1 inch.

3. Completion of the treatment after another hour by spraying with water alone in large enough quantity to moisten the deposit throughout.

The dust on the roadway was laid satisfactorily and it dried within a day to give a firm floor. Subsequently the floor was treated at intervals of 2 to 3 weeks with water roughly applied from a hose in sufficient quantity to bind any loose surface material. It is reported that the treatment has rendered this section of road pleasant to travel and has eliminated the dust cloud that formerly attended traveling.

Tests on other lengths of roadway in this mine showed that (1) periodic watering was adequate to cope with much more than the moderate deposition of fresh dust on this roadway; (2) for thinner dust deposit, the second spraying with Perminal solution might be omitted without disadvantage and with economy; and (3) a fine spray is not essential, though preferable for the initial application of Perminal solution, while for subsequent spraying and for the periodic treatment with water a coarse spray is adequate.

The Perminal treatment was applied also on traveling and on haulage roads of several other British collieries; these experiences are described briefly in Safety in Mines Research Board annual reports for 1935[13] and 1936.[14] The work showed that spraying with the Perminal solution is adequate for several months to 1 year and possibly longer. Re-treatment with water alone is necessary to recondition the road after the firm, dry surface has been eroded with use; the frequency of rewatering depends on the rate of drying and on the extent of mechanical erosion. If an excess of water is avoided, it penetrates the dust layer but does not affect the underlying solid floor adversely.

As an alternative to frequent rewatering, hygroscopic salts have been applied successfully in several instances after initial treatment with Perminal; solutions of calcium chloride have been found most useful for this purpose over a wide range of humidity. Applied in the ordinary way, a calcium chloride solution does not wet mine dusts readily but stands in pools, being worse than water in this respect; if previous treatment with a wetting agent had been made, it was found that the calcium chloride solution was taken up readily, and it enabled the treated roadways to maintain a consolidated and damp condition over prolonged periods without recourse to frequent watering.

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[13] Mines Department of Great Britain, Safety in Mines Research Board, Fourteenth Annual Report, 1935: H.M. Sta. Office, London, 1936, pp. 21-25.

[14] Mines Department of Great Britain, Safety in Mines Research Board, Fifteenth Annual Report, 1936: H.M. Sta. Office, London, 1937, pp. 50-51.

Experience indicated that the calcium chloride could be applied conveniently as an approximately 30-percent solution or, if necessary, as a more concentrated solution, by one or more applications from ordinary watering cans fitted with sprinklers. About 4 gallons of solution per 100 square feet may be sprinkled in one application, and this should be allowed to soak in before the next sprinkling. A few days should elapse between the treatment with a wetting agent and the application of calcium chloride to allow slow and deep permeation of the wetting agent into the dust deposit.

At temperatures between 40° and 85°F. and relative humidity above 40 percent there is no danger that calcium chloride will dry out. At lower humidity it may be necessary to water it more frequently to insure retention of enough moisture. The amount of calcium chloride required varies with the thickness of the dust deposit and with the relative humidity of the mine atmosphere; it is almost independent of the temperature between 40° and 85°F. If the dust requires approximately 10 percent moisture for adequate consolidation, the proportion of calcium chloride needed in the dust, applied after the wetting agent, decreases from 6 to 2 percent when the relative humidity of the atmosphere increases from 50 to 90 percent.

In mines where the relative humidity of the atmosphere is more than 75 percent, common salt was found to be equally as effective as calcium chloride for binding the floor dust after treatment with a wetting agent. In dryer atmospheres sodium chloride does not retain moisture, but crystallizes and becomes dry.

Based on the trials in the roadway of the Thorpe colliery, part of which was treated with calcium chloride as well as Perminal, the following rough estimate of the cost of the treatment is given for a 1-mile length of roadway 10 feet wide:[15]

	Weight	Dollars
Perminal, at 4 gallons of 3-percent solution per 100 square foot of surface, at an estimated price of 33 cents per pound................	630 lb.	210
Calcium chloride, at a rate ranging from 20 to 50 pounds per 100 square foot of floor surface, according to the dryness of the mine air; at $28 per short ton (estimated).........................	5.3 to 13.4 tons	120 to 300

Total cost of materials thus ranges from $330 to $510 per mile of 10-foot roadway. In computing the costs in the above table, 1 pound sterling has been taken equal to 5 dollars.

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[15] Mines Department of Great Britain, Safety in Mines Research Board, Work cited in footnote 13.

Suppression of Coal-Dust Clouds

The allaying of dust clouds in the mine atmosphere is considerably more difficult than the consolidation of dust already settled on roadways. As previously mentioned, the Bureau of Mines recommends the use of watering, traps, dust collectors, and other means for reducing the dust nuisance caused by drilling, blasting, and hauling.

In Great Britain much work has been done recently in investigating the usefulness of wetting agents in connection with water sprays and mist projectors for laying dust clouds. Although many difficulties were encountered, chiefly in suppressing very fine dust particles, some progress has been made. One of the troubles arises from the fact that in many operations the wetting solution is in contact with the dust for only a few seconds, which necessitates the use of wetting agents of very high activity.

In connection with dust suppression during drilling, it was reported recently[16] that extensive trials with wet drilling showed that dust is liberated in appreciable quantity only if air is allowed to leak down the drill steel. With external water feed such leakage was reportedly eliminated; as such equipment is on the market, the employment of wetting agents in wet drilling is felt to be unnecessary, except possibly for rock, which is particularly difficult to wet.

The settling of coal-dust clouds at loading points and during blasting was attempted by spraying the cloud with solutions of wetting agents and by catching it on cloths soaked in solutions of wetting agents. Other means tried were compressed-air mist projectors, mechanically formed mists, turbulent passage through water, and filtration by means of a compressed metal-wool mattress.

Dust was suppressed successfully at loading points when mist projectors were used. In this connection, solutions of wetting agents have been found to be superior to water alone in producing a more thoroughly wetted material with less likelihood of subsequent dispersion in the atmosphere. The Hay mist projector is reported to be particularly useful in this work. It is reported in one study[17] that an efficiently designed plant removes about 95 percent of the coal dust at loading points; some of the finer particles are not removed. These plants were of the enclosed type, and it is suggested that mist produced in the open, as at the face for removal of dust during cutting and after blasting, may be objectionable.

In a more recent study,[18] tests were made with mist projectors during drilling, shot-firing, and loading in a rock heading. The use of projectors was found to be very beneficial in reducing the concentration of the dust.

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[16] **Mines Department of Great Britain, Safety in Mines Research Board,** Fifteenth Annual Report, 1936: H. M. Sta. Office, London, 1937, p. 111.

[17] Graham, J. Ivon, Skinner, D. G., and Walton, W. H., The Reduction of Dust in the Vicinity of Underground Loading Points: Trans. Inst. Min. Eng., vol. 94, 1937-38, pp. 260-287.

[18] Graham, J. Ivon, Skinner, D. G., and Walton, W. H., The Production of Dust in Hard Headings and Means for Its Suppression: Trans. Inst. Min. Eng., vol. 97, 1938-39, pp. 83-103.

Tests in an experimental gallery also showed that adding increasing quantities of wetting agent (0.05 to 0.25 percent) to the water used in the mist projector reduced progressively the peak values reached by the dust concentration, while at the same time it had little effect on the time required for the complete elimination of the dust particles; shale dust was used in these tests.

SUMMARY

The British tests described above show that the nuisance of dust clouds in coal mines can be abated and that wetting agents can play an important part in the work. The American tests indicate that wetting agents can do nothing directly toward preventing coal-dust explosions. Indirectly - and this is highly important - their proper use can assist in preventing explosions by extending greatly the life of a given application of rock dust. Proper wetting will permit effective rock dusting at points where mechanical handling of dry, friable coal now produces and scatters so much coal dust that the incombustible content of all the dust falls below the required minimum in as little as a single shift of operation.

There is available in the United States a wide variety of wetting agents, but their applicability to conditions in coal mines has not been investigated to any great extent and in some instances not at all. Laboratory tests might give a preliminary indication as to their suitability, but trial underground will be necessary to determine whether or not they produce desired results.